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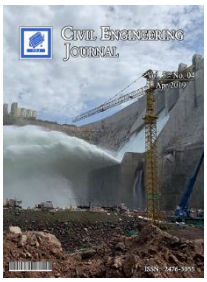

Combined Influence of Fly Ash and Recycled Coarse Aggregates on Strength and Economic Performance of Concrete

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Abstract

Recycled coarse aggregates (RCA) and fly ash (FA) are materials with least to very low global warming potential. Considering long term strength and durability, various studies have suggested to use RCA in concrete with FA. This research paper deals with the strength and economic performance of concrete made with individual and combined incorporation of FA and RCA. Nine different mixtures of concrete were prepared by varying the incorporation levels of RCA and FA. 0% RCA, 50% RCA and 100% RCA were used in concrete with three different levels of FA (0%FA, 20%FA, and 40%FA). The compressive strength of each mixture of concrete was determined at the age of 3, 28, 90 and 180 days. To evaluate economic performance cost of 1 m^3 of each mixture of concrete was compared to that of the control mixture having 0% RCA and 0% FA. Results showed that RCA was detrimental to the compressive strength of concrete at all ages, whereas, FA reduced early strength but improved the strength at later ages of testing i.e. 90 and 180 days. FA plus RCA mixes also showed lower early age strength but gained higher strength than conventional concrete at the age of 180 days. RCA did not reduce the cost of concrete effectively. FA despite having a very high transportation cost, it reduced the cost of concrete efficiently. FA did not only reduce the cost of binder but also lower the demand of plasticizer by improving workability. Cost to strength ratio (CSR) analysis also indicated that FA significantly improve the combined economic and strength performance of RCA concrete mixes.

Keywords: Recycled Aggregate Concrete; Recycled Aggregates; Fly Ash; Compressive Strength; Economic Performance.

1. Introduction

Concrete is used more than any other manmade material in the world due to its unique advantages. Formability, higher strength and durability, and the cost-effectiveness of OPC concrete makes it more adaptable material than other conventional materials such as wood, steel, bricks, stones, etc. But it possesses a very high global warming potential associated with its vital components such as OPC and NCA.

In construction industry necessity for sustainability is obvious. Not only construction industry should lessen its carbon footprint, but it should also contribute to preserve the natural resources which are vital for continuous growth and long-term economy. Therefore, waste materials are undergoing extensive research worldwide so that they can be replaced with the conventional materials in order to lessen the impact of the construction industry on environment, society and economy. The requirement of NCA to produce the concrete will reach to about 40 billion tons/annum with coming 20 years [1, 2]. On the other hand, construction and demolition activities generate 90 million tons of waste in major countries around the world i.e. Japan, Europe and USA [3]. In this scenario, best practice would be to streamline C&DW into the concrete industry by manufacturing recycled aggregates. On the other hand, total world production of Portland cement

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